

Western Ecological Research Center

Publication Brief for Resource Managers

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Which Trees Will Be Killed by Fire? Pre-Fire Growth Rate is a Factor

One of the primary tools available for thinning overly dense forests and restoring forest health is prescribed fire. Confidence in forecasting the outcomes of prescribed burns requires knowledge of which trees are most likely to be killed by a fire. In a study recently published in the *Canadian Journal of Forest Research*, USGS scientists Drs. Phil van Mantgem and Nate Stephenson and their colleagues addressed this issue using a unique long-term data set, consisting of observations of thousands of trees over a period of 16 years. They found that the rate of tree growth before a fire, in addition to crown scorch from fire, influences probability of tree death following fire.

Individual tree death occurs as a result of many different long-term and short-term stressors. Mortality in unburned stands is usually the result of suppression, such as shading from neighboring trees. Low growth rates are therefore predictive of tree mortality probabilities from this long-term stress. In contrast, our understanding of fire-caused tree mortality emphasizes the results of short-term fire damage (e.g., crown scorch). Using observations of 2,622 unburned and 688 burned white fir trees (*Abies concolor*) in the Sierra Nevada of California, the authors found that growth rate was a significant predictor of mortality in the unburned stands, while both crown scorch and growth rate were significant predictors of mortality in the burned stands.

This finding suggests that resource managers will need to consider the effects of stresses interacting with fire. For example, if tree growth is reduced by air pollution, climatic change, increasing forest density, or other stresses, there will likely be a *de facto* increase in fire

Management Implications:

- Predictions of post-fire tree mortality are improved by including measurements of pre-fire tree vigor, along with severity of fire-caused damage.
- The frequency of trees killed by fire is at least partially dependent on the pre-fire stand conditions.
- Chronic stresses interacting with fire may lead to a *de facto* increase in fire severity (trees killed), even when there is no change in fire intensity.

severity (numbers of trees killed), even when there is no change in fire intensity.

van Mantgem P. J., N. L. Stephenson, L. S. Mutch, V. G. Johnson, A. M. Esperanza, and D. J. Parsons. 2003. Growth rate predicts mortality of *Abies concolor* in both burned and unburned stands. *Canadian Journal of Forest Research* 33:1029–1038.